



Plants and fungi in the ethnomedicine of the medieval East - a review

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Review

Abstract

Background: In the history of medicinal science of the medieval East, the merits of the great tabibs-physicians Ar-Razi, Avicenna (Ibn Sino), the scientist-encyclopedist Beruni, Yusufi and others are enormous. When treating patients, they used medicinal plants, as well as fungi, animal (ornithological) and mineral products. Such use of plants for medicinal purposes goes back centuries. In this review, we present a compilation of the most important plant species and fungi used in the traditional medicine of the medieval East.

Methods: We have obtained ethnomedicinal information by searching various resources, such as scientific and popular journal papers, monographs, books written in Uzbek, Russian and English, and our materials focused on the traditional use of medicinal plants and fungi. Scientific names, both of plants and fungi were checked for potential synonyms in the databases Index Fungorum and Plants of the World Online (POWO).

Results: Based on literary data on taxonomy, resource science, as well as folk and scientific medicine, we compiled a list of plant families used by healers and medicines of the Middle East. According to our results, 173 species of medicinal plants were used and described by Ar-Razi, 515 by Avicenna, 901 in Beruni, and 110 as well as a few fungal species in Yusufi. Among the medicinal plants used by Ar-Razi, Avicenna and the Beruni listed in Saidana are more than 240 species currently found in the flora of Uzbekistan.

Conclusion: On the face of the fact that the centuries-old experience of traditional medicine, generalized in the works of scientists from the Middle East, has found its confirmation at the present time. Most of the medicinal plants indicated by them are now included in the Pharmacopoeias of many countries, from which both independent medicinal products were obtained, and biologically active substances were isolated that serve in the improvement of the population. Given the growing interest in medicines of natural origin, work in this direction will continue.

Key words: Ethnobiology, Plants, Fungi, Folk Medicine, Scientific Medicine

Background

People have known the healing and empowering properties of various herbs since ancient times, and they have used this knowledge in the treatment of various diseases. For example, in ancient Egypt, India, China, Central Asia and many other countries, physicians wrote many manuscripts on the healing properties of herbs. It is possible to find among them medicinal ingredients made from various herbs that have not lost their value and are used in practice (Iwu 1994; Hamed 2009; Ajmad *et al.* 2015; Malik *et al.* 2015; Raj *et al.* 2018; Souza *et al.* 2018; Živković *et al.* 2020).

Nowadays, everything is being forgotten faster and the memory of the folk traditional use of local plant species in different branches of a person's daily life, using them as amulets without saying already about the treatment of diseases, and their role in traditional folk rituals. That is why it is so important to be in time to collect and preserve, generalize and analyze this passing true folk knowledge (Tkachenko, Lebedeva 2008).

Eastern folk medicine or traditional medicine has held a special fascination for ethnographers, anthropologists, and ethnobiologists alike. Knowledge of folk medicine has been passed down via both written and oral pathways over centuries, and has been incorporated into Greek, Arab and other medical theories. While some of these medical traditions have survived the passage of time relatively intact, many others have changed or disappeared, while "new" remedies and uses have also emerged (Azaizeh *et al.* 2006).

Traditional medical knowledge is always in a state of flux. In many cases, local traditional knowledge regarding the environment, wild food and medicine sources, and human health are however in an alarming state of decline. This has prompted researchers to pursue studies to document, preserve and compare data concerning these unique local ethnomedical practices. In countries like Uzbekistan and in the Central Asian region, ethnobiological studies can enhance our understanding not only of traditional healthcare practices but also provide insight into human health and offer new solutions for food security. Specifically, ethnobiological data can provide a basis for understanding folk medical beliefs about sickness, health, and therapies that are useful to medical doctors charged with the care of populations that now mostly use allopathic treatments. Moreover, much research into the medicinal and nutritional value of plants and fungi those are presently underused in mainstream culture and may actually lead to the development of the foods, pharmaceuticals, and drugs of tomorrow (Ramalingum, Mahomoodally 2014; Howes *et al.* 2020).

Materials and Methods

Short information study site

In this article, Transoxiana is regarded as the region covering is the historical territories of Central Asia. The Transoxiana is located in Central Asia, between the Amudarya and Syrdarya rivers. The territory in the north and northeast borders with Kazakhstan, in the east and southeast - with Kyrgyzstan and Tajikistan, in the west - with Turkmenistan, in the south - with Afghanistan. Nowadays it covers the territories of five modern countries: Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan (Burghart and Sabonis-Helf 2018).

The geographic location of Transoxiana

This includes a desert located between the Amu Darya and Syr Darya river basins. The Transoxiana territories were occupied by a desert called Kyzyl-Kum. In the south and south-east regions are the Pamir-Alai and Tian-Shan mountains. The altitude ranges from 200 m in the desert to almost 6,000m at the mountain peak. The riversides are densely populated by Kazakhs, Karakalpaks, Kyrgyz, Turkmen, and Uzbeks (Burghart and Sabonis-Helf 2018).

In the Middle Ages, Central Asia was inhabited mainly by Turks and Iranians. After the arrival of the Arabs in the region in 650-715 AD, Islam spread throughout the region and became an integral part of the culture of the people of the region. Medicine flourished in regions where Islam was widespread, and local people enriched it with their own medical traditions. Each of the plains, foothills, and mountainous regions of Central Asia has its own fauna, flora and fungi. It is from these gifts of nature that the healing culture of local people has grown, prescribing medicines for them Ibn Sina, Ar-Razi, and other scholars expected these medical traditions to reach the academic level (Lubin 1984).

Central Asia Population

Nowadays population of Central Asia is more than 75 978 668 people (<https://www.worldometers.info/world-population/central-asia-population/>). Many nationalities and ethnic groups live here such as Uzbeks, Karakalpak's, Tajiks, Turkmen, Kazakhs, Kyrgyz, Uighurs, Dungan's; Western and Eastern Slavs: Russians, Ukrainians, Belarusians,

Poles; numerous diasporas in five countries are Koreans, Iranians, Armenians, Georgians, Azerbaijanis, Tatars, Bashkir's, Germans, Jews, Lithuanians, Greeks, Turks, and many other nationalities (Lubin 1984)

Data Collection

We have obtained ethnomedicinal data from books written by Ar-Razi, Avicenna, Beruni, and Yusufi in the 10-11th and 16th centuries, as well as various resources about their scientific works in scientific and popular journal papers, monographs, books written in Uzbek, Russian, English, and own materials, focused on the traditional use of medicinal plants and fungi. In addition, scientific names OF both plants and fungi were checked for potential synonyms in Index Fungorum (date accessed 10/04/2021) and Plants of the World Online (POWO) (date accessed: 09/07/2021) and a modern list of plants and fungi was compiled.

Results and Discussion

According to our results, to 173 species of medicinal plants were used and described by Ar-Razi, 515 by Avicenna, 901 in Beruni, and 110 in Yusufi. Medicinal plants and fungi mentioned in the works of Ar-Razi, Avicenna, al-Beruni and Yusufi are now found in the flora of many other countries around the world.

This information in this review was based on information from the books of Ar-Razi (Clinical records of Abu Bakr Razii 1994; Ar-Razi 1994; Taizhanov *et al.* 2003), Avicenna (Ibn Sina 1996), Beruni (Abu Raikhan Beruni 1973; Sobirov *et al.* 1993) and Yusufi (Khasani 1992; Toyzhanov, Kholmatov 1998), and other literary sources on folk and scientific medicine (Muravyova 1964; Wolf, Maleeva 1969), as well as our own materials. The names of the plants were given based on the Flora of Uzbekistan (Flora of Uzbekistan 1941-1962), Keys of Central Asian plants (Keys to plants of Central Asia 1968-1993) and Vascular Plants of the USSR (Cherepanov 1995). Many plant names may be etymologically related to the names of wild and domestic animals, birds, and insects. In the Uzbek language, there are plant names associated with the names of animals, such as "Otqulok - Horse" (*Rumex*) "Echkitol - Goat" (*Salix*) (Flora of Uzbekistan 1953), "Arslonquyruq - Lion" (*Leonurus*), "Burigul - Wolf" (*Vinca*) (Flora of Uzbekistan 1961), etc. In the fundamental key book "Flora of Uzbekistan" (Vol. 6.) there are more than 200 such Uzbek names of plants. The names of plants associated with the names of animals, birds and insects are also found in the works of Ar-Razi, Avicenna, Beruni and others (Sobirov *et al.* 1993; Khalmatov 1999; Taizhanov *et al.* 2003). The names of many medicinal plants in Arabic and Persian have been preserved in Uzbek language today (Khojimatov 2021).

A short history of important scholars

For thousands of years, the books of medieval medicinal scholars have been translated into many languages of the world. It is known that e.g., Avicenna's "al Qanun fit Tibb" in Arabic and "The Canon of Medicine" has been translated into Latin only more than 40 times.

Avicenna (Abu Ali Hussin bin Abdallah ibn Hasan ibn Ali ibn Sino) was born in 980 in the village of Afshana, present day Bukhara region in Uzbekistan. He is one of the outstanding encyclopedist scholars of the medieval East, who made a huge contribution to the history of world science and culture. His scientific heritage includes a variety of industries: philosophy, medicine, astronomy, mathematics, physics, poetry, music. In his autobiography, he writes "I didn't sleep all night, I didn't rest from morning till night, and I didn't do anything but mental work." (Ibn Sina 1996). The results of such work were reflected in his creative activity as a medical scientist. He lived and worked in many cities in Bukhara, Gurganj, Nishapur, Hamadan, Jurjan. As the ruler of Hamadan, he spent 9 years as a treating physician and vizier. In Hamadan, he began to write the "Book of Healing" (Kitab al-Shifa), then the first book with 5 volumes, "The Canon of Medical Science", which he finished all volumes in 1020. Numerous wanderings, continuous hard work exhausted the health of Avicenna. He died in 1037 in Hamadan. Avicenna's contribution to the development of medicine was especially significant, amounting to more than 55 books, of which 31 were written by Ibn Sina (Arzumetov, Yuldashev 1983). The "Canon" ("Kitab al-kanun fi-t-tib") - the main medical work of Avicenna is a genuine medical encyclopedia. For many centuries, this work of Avicenna served as the main medical guide of many countries, including in the East. The author himself divided the "Canon" into five books. The second book of the Canon is an encyclopedia of medicines. More than 800 medicinal agents of vegetable, mineral, and animal origin are described. It combines the experiments of medicine of ancient Rome, Greece, India, Iran and Central Asia (Karimov 1973). Of the 810 drugs listed in the second book of Canon, 515 are medicinal plants (and their agents), 125 products of animal origin, 85 minerals (Khalmatov 1958, 1999; Taizhanov, Taizhanova 2009). In addition to higher plants, it contains lichens (*Leconora*, *Roccellia*, *Usnea*) and fungi (*Morchella*, *Fomitopsis*, *Tuber*). Avicenna divides drugs into simple and complex ones. Simple consists of one plant (or resources), complex numbers from 4-6 to 10-15 items. Means are consisting of 60-80 plants and means of animal and mineral origin. In addition

to drugs prepared by hand, he used the medicine of other authors, such as Barmacius (composition of 5 plants), Antil (7 plants), Andromachus (9 plants), Aristotle (25 plants), Mithridates (57 plant species).

Ar-Razi (Abu Bakr Muhammad ibn Zakariya Al Razi) was born in the city of Al Rayy in August 865 AD, and he died in Al Rayy on October 27, 925 at the age of 60 years. In his youth, he was fond of literature, music, philosophy, geography, astronomy, and other branches of science. However, he was engaged in the treatment of patients in older age. He lived only 60 years, but among more than 180 scientific papers 56 are devoted to treatment. In his book "Clinical Records of Abu Bakr Razi and His Disciple," as well as "Clinical Records" (both books were reprinted in Tashkent in 1974), the healing properties of 180 plant species belonging to 72 families are given in Uzbek (Clinical records of Abu Bakr Razii 1994; Ar-Razi 1994). In addition, he used more than 60 products of animal (including ornithological) and mineral origin (Clinical records of Abu Bakr Razii 1994; Ar-Razi 1994; Taizhanov *et al.* 2003).

Beruni (Abu Raihon Muhammad ibn Ahmad Al Beruniy) was born in Khorazm in Kiyat city in 973. He wrote more than 150 works devoted to almost all branches of knowledge of that time. Some works (Chronology, India, Geodesy, Canon Masuda) are published in translation into Russian, Uzbek and Western European languages and are available to a wide range of readers. Among Beruni's works, the last work "Kitab as Saidana fi-t-tibb" (abbreviated "Saidana") in terms of volume and content is a valuable source on the history of medicinal science in the medieval East (Abu Raikhan Beruni 1973). This work of Beruni differs from other works devoted to pharmacognosy, even from Avicenna's second book, The Canon of Medical Science, because it focuses not on the properties and effects of drugs, but on their definition, since in the medical literature of that time there were more foreign-language names of drugs that were not known to all doctors. He cited in work about 4,500 names of plants, animals, minerals, and other products obtained from them, in different languages of the people of the East of that time (Karimov 1973). Of the 1116 paragraphs given in the book, 901 plant species are devoted to medicinal herbs, 104 to animal products, 124 to minerals. However, the appendix contains information about 116 plants. Currently, of the plants reported by Beruni, 135 species are growing in the territory of Uzbekistan as wild, 89 species are as cultivated plants (Sobirov *et al.* 1993). Among them, 56 plant species are used in modern medicine and 114 in folk medicine (Taizhanov, Taizhanova 2009).

Yusufi (Yusufi ibn Muhammad ibn Yusuf al-tabib al Harawi) was born in the second half of the 16th century in Khorasan. According to written sources, he learned to heal from his father. After arriving in Herat, he and his father worked in the "Medical House" ("Dorushshifo"), founded by the poet Alisher Navoi. He was one of the first physicians to investigate syphilis and healing of the disease with his medicines. He was one of the first doctors to diagnose syphilis and treat the disease with his own medications. After Babur (born in Andijan) conquered of India, he invited Yusufi to this country as a personal family physician. Among the works, he wrote on healing, "Jamiu-l-favoyid" ("Tibbi Yusufi") is a kind of lyrical essay - quadruple? ("Rubayat"), which gives the therapeutic properties of 108 wild and cultivated plants (Khasani 1992; Toyzhanov, Kholmatov 1998).

Based on literary data on taxonomy (Flora of Uzbekistan 1941-1962; Keys to plants of Central Asia 1968-1993; Cherepanov 1981), resource science (Wolf, Maleeva 1969), as well as folk and scientific medicine (Muravyova 1964; Sokolov, Zamotaev 1984), we compiled a list of plant families used by healers and medicines of the Middle East. In Table 1, taxa are given alphabetically according to the system of Angiosperm Phylogeny Group (APG IV 2016).

Among the medicinal plants used by Ar-Razi, Avicenna and the Beruni listed in Saidana are more than 240 (Ar-Razi 1994; Ibn Sina 1996; Beruni 1973) species currently found in the flora of Uzbekistan (Flora of Uzbekistan 1941-1962). These plants in Table 2 below are arranged in alphabetical order.

Thus, it was found that the medicinal plants used and cited in the works of Ar-Razi (149 genera with 173 species) (Clinical records of Abu Bakr Razii 1994; Ar-Razi 1994), Avicenna (365; 515 species) (Ibn Sina 1996), Beruni (505; 901 species) (Beruni 1973) and Yusufi (91; 110 species) (Khasani 1992) belong to 136 families (Fig. 1. and Table 1). Currently, these medicinal plants are found in the flora of more than 30 countries - this proposal has already been highlighted in many places, including in Uzbekistan (240 species), and are also used successfully in folk and scientific medicine.

Table 1. List of plant families used by healers and medicines of the Middle East (Data from Sobirov *et al.* 1993, Khojimatov *et al.* 1995, Toyzhanov and Kholmatov 1998, Khalmatov 1999, Taizhanov and Taizhanova 2009, Taizhanov *et al.* 2003, Khojimatov 2021).

Family	Scientist/Scholar								Use in medicine	
	Avicenna		Ar-Razi		Beruni		Yusufi		Folk	Modern
	Genera	Species	Genera	Species	Genera	Species	Genera	Species		
Alismataceae	1	2			1	1				
Altingiaceae	1	1			1	1				
Amaranthaceae	6	11	2	2	9	23	2	2	2	
Amoryllidaceae	2	6	1	3	3	8	1	1	3	
Anacardiaceae	3	5	3	4	4	7	3	3	5	4
Apiaceae	29	40	13	13	36	63	5	8	18	8
Apocynaceae	5	6			8	14				
Araceae	3	3	1	1	7	10	2	2	1	1
Araliaceae	1	1	1	1	1	1				
Arecaceae	4	4			5	5	1	1		
Aristolochiaceae	2	3	2	2	2	3	2	3	2	
Asparagaceae	7	7	2	2	7	10	1	1	2	
Asphodelaceae	3	3	1	1	2	5	1	1	1	1
Aspleniaceae	2	2			3	4	1	1	1	1
Asteraceae	27	36	10	13	47	80	7	7	17	6
Berberidaceae	2	3	1	1	2	4			1	
Betulaceae	1	1	1	1	1	1	1	1	1	
Boraginaceae	6	8	1	1	8	9	1	1	2	
Brassicaceae	11	19	2	5	18	33	2	3	5	2
Burseraceae	2	5	2	3	3	11	1	4	5	2
Buxaceae					1	2				
Campanulaceae					1	1				
Cannabaceae	1	1			2	3			1	
Capparaceae	1	1	1	1	3	3			1	
Caprifoliaceae	2	3	1	1	2	5	1	1	1	1
Caryophyllaceae	4	3	1	1	8	11			1	
Cistaceae	1	2	1	1	1	3			1	
Combretaceae	1	2	1	1	1	4	1	2	2	1
Convolvulaceae	3	5	3	3	3	9	3	3	3	1
Cornaceae	1	1			1	2				
Costaceae	1	1			1	1				
Crassulaceae	1	1			2	2				
Cucurbitaceae	5	7	4	5	8	17	1	1	5	1
Cupressaceae	3	5	1	1	3	5			1	1
Cynomoriaceae	1	1	1	1	1	1			1	
Cyperaceae	1	4	1	2	1	4	1	2	2	
Dioscoreaceae	1	1			1	1				
Dipterocarpaceae					1	1				
Droseraceae					1	1				
Ebenaceae	1	1			1	1				
Elaeagnaceae	1	1			1	1				
Ephedraceae					1	?				
Equisetaceae	1	1			1	1				
Ericaceae					1	1				
Erythroxylaceae					1	1				
Euphorbiaceae	6	9	2	2	9	19	3	3	5	2
Fabaceae	32	44	14	17	41	84	6	7	17	7
Fagaceae	2	3	1	1	4	8			1	
Gentianaceae	2	2	1	1	3	4	2	2	2	1
Geraniaceae	1	1			1	1	1	1	1	1
Haloragaceae					1	1				
Hamamelidaceae			1	1	1	1			1	1
Hypericaceae	3	3	1	1	3	5			1	
Icacinaceae					1	1				
Iridaceae	4	5	2	2	3	4	1	1	2	1
Juglandaceae	1	1	1	1	1	1	1	1	1	1
Juncaceae					1	4				

Family	Scientist/Scholar								Use in medicine	
	Avicenna		Ar-Razi		Beruni		Yusufi		Folk	Modern
	Genera	Species	Genera	Species	Genera	Species	Genera	Species		
Lamiaceae	14	31	7	9	19	43	3	3	9	6
Lauraceae	2	5	2	4	4	12	2	3	4	3
Lecanoraceae	1	3			1	2				
Liliaceae	4	5			4	7	1	1	3	
Linaceae	1	1	1	1	1	1			1	1
Loganiaceae			1	1	1	1			1	1
Loranthaceae	1	1			1	1				
Lythraceae	3	3	1	1	4	5	?	1	1	
Malpighiaceae					1	1				
Malvaceae	7	7	4	4	7	10			4	2
Marsileaceae					1	1				
Melastomataceae					2	3				
Meliaceae	1	1			3	3				
Menispermaceae	1	1			2	2				
Montiniaceae					1	1				
Moraceae	2	6	1	1	3	12			1	1
Morchellaceae	1	1			1	1				
Moringaceae	1	2	1	1	1	2	1	2	1	
Musaceae	1	1			1	2	1	1		
Myristicaceae	1	1			1	2	1	1	1	1
Myrtaceae	3	3	2	2	3	3	1	1	2	2
Neuradaceae					1	1				
Nitrariaceae	1	1			1	1				
Nymphaeaceae	1	2	1	1	4	7			1	
Oleaceae	3	4	2	2	3	8	?	1	3	2
Onagraceae					1	1				
Orchidaceae	1	4			1	4	1	1	1	1
Oxalidaceae					1	1				
Paeoniaceae	1	1			1	1				
Pandanaceae					1	2				
Papaveraceae	4	3	4	4	5	7	2	2	6	4
Pedaliaceae	1	1	1	1	1	2	1	1	1	1
Penaeaceae			1	1	1	1			1	1
Pinaceae	4	7			3	6			1	
Piperaceae	1	4	1	4	1	4	1	3	4	2
Plantaginaceae	1	2	1	1	1	2			1	1
Platanaceae	1	1			1	1				
Plumbaginaceae	2	2			1	2				
Poaceae	16	18	7	7	23	37	1	1	7	1
Polygonaceae	3	7	2	2	6	13			1	
Polypodiaceae	4	4	2	2	3	5	1	1	2	1
Polyporaceae	1	1			1	1	1	1	1	
Portulacaceae	1	2	1	1	1	2			1	
Potamogetonaceae	1	1			1	1				
Primulaceae	5	4			5	5	1	1	1	
Pteridaceae	1	1			2	2	1	1	1	1
Ranunculaceae	6	8			7	14	2	2	2	1
Resedaceae	1	1			1	1				
Rhamnaceae	2	3	1	1	2	5	1	1	2	2
Rhizophoraceae					1	1				
Roccelaceae	1	1			1	1				
Rosaceae	12	20	6	6	11	30			6	2
Rubiaceae	2	2	1	1	3	4			1	1
Rutaceae	6	6	2	3	7	11	2	3	4	3
Salicaceae	3	8			3	10	1	1	1	
Salvadoraceae					1	1				
Santalaceae	1	1	1	1	3	3	1	1	1	
Sapindaceae	1	1			1	1				
Sapotaceae	1	1			1	1				
Scrophulariaceae	3	5			3	5	1	1	1	
Smilacaceae					1	1				

Family	Scientist/Scholar								Use in medicine	
	Avicenna		Ar-Razi		Beruni		Yusufi		Folk	Modern
	Genera	Species	Genera	Species	Genera	Species	Genera	Species		
Solanaceae	6	9	3	3	8	19	2	2	4	1
Styracaceae	1	1			1	1				
Symplocaceae	1	1			1	1				
Tamaricaceae	1	1	1	1	1	3	1	1	1	
Taxaceae	1	1			1	1	1	1	1	
Theaceae					2	2				
Thymelaeaceae	4	5	2	2	4	6	1	1	2	
Tuberaceae	1	1			1	4				
Typhaceae					1	1				
Ulmaceae	1	2			2	2				
Urticaceae	2	4	1	1	2	4			1	1
Usneaceae	1	1			1	2	1	1	1	1
Verbenaceae	2	2			4	4	1	1	1	
Viburnaceae					1	2				
Violaceae	1	1	1	1	1	1			1	
Vitaceae	1	2	1	1	3	6	1	1	1	1
Zingiberaceae	5	8	4	5	5	10	3	4	5	1
Zygophyllaceae	2	2	1	1	3	4			1	1
Total	365	515	149	173	505	901	91	110	214	91

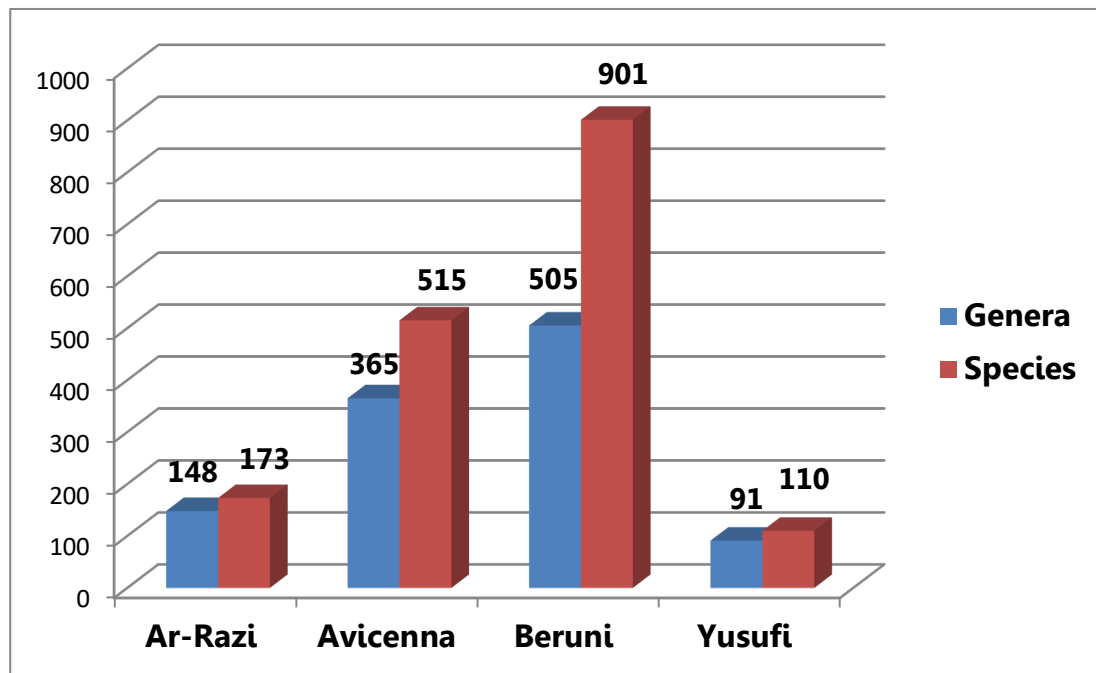


Figure 1. Number of plant species and genera used by Islamic scholars in medieval East.

Table 2. List of plant species used in traditional Islamic medicine. (Data from Sobirov *et al.* 1993, Khojimatov *et al.* 1995, Toyzhanov and Kholmatov 1998, Khalmatov 1999, Taizhanov and Taizhanova 2009, Taizhanov *et al.* 2003, Khojimatov 2021).

Plant species	Family	Ar-Razi	Avicenna	Beruni	Use in medicine	
					Folk	Modern
<i>Abutilon theophrasti</i> Medik.	Malvaceae		1		1	
<i>Achillea millefolium</i> L.	Asteraceae			1	1	1
<i>Achillea tenuifolia</i> Lam.	Asteraceae		1	1	1	1
<i>Acorus calamus</i> L.	Araceae	1	1	1	1	1
<i>Adiantum capillus-veneris</i> L.	Pteridaceae	1	1	1	1	1
<i>Aeluropus lagopoides</i> (L.) Thwaites	Poaceae			1		
<i>Agrostemma githago</i> L.	Caryophyllaceae			1	1	
<i>Alhagi maurorum</i> Medik.	Fabaceae	1	1	1	1	
<i>Alisma plantago-aquatica</i> L.	Alismataceae		1	1	1	

Plant species	Family	Ar-Razi	Avicenna	Beruni	Use in medicine	
					Folk	Modern
<i>Alkekengi officinarum</i> Moench	Solanaceae	1	1	1	1	
<i>Allium ampeloprasum</i> L.	Amaryllidaceae		1	1	1	
<i>Allium cepa</i> L.	Amaryllidaceae	1	1	1	1	1
<i>Allium sativum</i> L.	Amaryllidaceae	1	1	1	1	1
<i>Aloe vera</i> (L.) Burm. f.	Xanthorrhoeaceae	1	1	1	1	1
<i>Althaea officinalis</i> L.	Malvaceae	1	1	1	1	
<i>Amaranthus blitum</i> L.	Amaranthaceae		1	1	1	
<i>Amaranthus cruentus</i> L.	Amaranthaceae			1	1	
<i>Amaranthus tricolor</i> L.	Amaranthaceae		1	1	1	
<i>Anchusa azurea</i> Mill.	Boraginaceae		1	1	1	
<i>Apium graveolens</i> L.	Apiaceae	1	1	1	1	1
<i>Artemisia absinthium</i> L.	Asteraceae	1	1	1	1	1
<i>Artemisia dracunculus</i> L.	Asteraceae	1	1	1	1	
<i>Artemisia vulgaris</i> L.	Asteraceae	1	1	1	1	
<i>Arundo donax</i> L.	Poaceae			1		
<i>Asparagus officinalis</i> L.	Asparagaceae	1	1	1	1	1
<i>Asplenium ceterach</i> L.	Aspleniaceae		1	1	1	
<i>Asplenium incisum</i> Thunb.	Aspleniaceae		1	1		
<i>Avena sativa</i> L.	Poaceae		1	1	1	1
<i>Berberis asiatica</i> Roxb. ex DC.	Berberidaceae	1	1	1	1	1
<i>Berberis vulgaris</i> L.	Berberidaceae		1	1	1	1
<i>Beta vulgaris</i> L.	Amaranthaceae	1	1	1	1	
<i>Brassica juncea</i> (L.) Czern.	Brassicaceae		1	1	1	1
<i>Brassica nigra</i> (L.) W.D.J. Koch	Brassicaceae	1	1	1	1	1
<i>Brassica oleracea</i> L.	Brassicaceae	1	1	1	1	
<i>Brassica rapa</i> L.	Brassicaceae	1	1	1	1	
<i>Bryonia alba</i> L.	Cucurbitaceae		1	1	1	1
<i>Bryonia dioca</i> Bojer	Cucurbitaceae		1	1	1	
<i>Buxus sempervirens</i> L.	Buxaceae			1		
<i>Calendula officinalis</i> L.	Asteraceae		1	1	1	1
<i>Calystegia sepium</i> (L.) R. Br.	Convolvulaceae			1	1	
<i>Cannabis sativa</i> L.	Cannabaceae		1	1	1	
<i>Capparis spinosa</i> L.	Capparaceae	1	1	1	1	1
<i>Carthamus tinctorius</i> L.	Asteraceae	1	1	1	1	1
<i>Carum carvi</i> L.	Apiaceae	1	1	1	1	1
<i>Castanea sativa</i> Mill.	Fabaceae			1		
<i>Cedrus deodara</i> (Roxb. ex D. Don) G. Don	Pinaceae			1		
<i>Celtis australis</i> L.	Cannabaceae			1		
<i>Cercis siliquastrum</i> L.	Fabaceae			1		
<i>Chelidonium majus</i> L.	Papaveraceae		1	1	1	1
<i>Chenopodium murale</i> (L.) S. Fuentes, Uotila & Borsch	Amaranthaceae			1		
<i>Chenopodium album</i> L.	Amaranthaceae			1	1	
<i>Chondrilla juncea</i> L.	Asteraceae			1	1	
<i>Chrysojasminum fruticans</i> (L.) Banfi	Oleaceae			1		
<i>Cicer arietinum</i> L.	Fabaceae	1	1	1	1	
<i>Cichorium intybus</i> L.	Asteraceae		1	1	1	1
<i>Citrullus colocynthis</i> (L.) Schrad.	Cucurbitaceae	1	1	1	1	1
<i>Citrus × limon</i> (L.) Osbeck	Rutaceae	1		1	1	
<i>Conium maculatum</i> L.	Apiaceae		1	1	1	1
<i>Convolvulus arvensis</i> L.	Convolvulaceae		1	1	1	
<i>Corchorus olitorius</i> L.	Tiliaceae		1	1		1
<i>Coriandrum sativum</i> L.	Apiaceae	1	1	1	1	1
<i>Cornus domestica</i> (L.) Spach	Rosaceae		1	1		
<i>Cornus mas</i> L.	Cornaceae		1	1		
<i>Corylus avellana</i> L.	Betulaceae	1	1	1	1	
<i>Crataegus pontica</i> K. Koch	Rosaceae		1	1	1	
<i>Cucumis maxima</i> Duchesne	Cucurbitaceae	1	1	1	1	1
<i>Cucumis melo</i> L.	Cucurbitaceae		1		1	
<i>Cucumis sativus</i> L.	Cucurbitaceae	1		1	1	
<i>Cuminum cyminum</i> L.	Apiaceae	1	1	1	1	
<i>Cupressus sempervirens</i> L.	Cupressaceae			1		

Plant species	Family	Ar-Razi	Avicenna	Beruni	Use in medicine	
					Folk	Modern
<i>Cuscuta epithymum</i> Siev. ex Ledeb.	Convolvulaceae	1	1	1	1	
<i>Cydonia oblonga</i> Mill.	Rosaceae	1	1	1	1	
<i>Cynodon dactylon</i> (L.) Pers.	Poaceae		1	1	1	
<i>Cynomorium coccineum</i> L.	Cynomoriaceae	1	1	1	1	
<i>Cyperus maculatus</i> Boeckeler	Cyperaceae	1	1	1	1	
<i>Cyperus rotundus</i> L.	Cyperaceae	1	1	1	1	
<i>Datura stramonium</i> L.	Solanaceae		1	1	1	1
<i>Daucus carota</i> L.	Apiaceae	1	1	1	1	1
<i>Delphinium semibarbatum</i> Bien. ex Boiss.	Ranunculaceae			1	1	1
<i>Dictamnus albus</i> L.	Rutaceae		1	1		
<i>Dryopteris filix-mas</i> (L.) Schott	Polypodiaceae		1	1		
<i>Ecballium elaterium</i> (L.) A. Rich.	Cucurbitaceae		1	1	1	
<i>Echinophora sibthorpiana</i> Guss.	Apiaceae		1	1	1	
<i>Elaeagnus angustifolia</i> L.	Elaeagnaceae		1	1	1	1
<i>Elymus repens</i> (L.) Gould	Poaceae		1	1	1	
<i>Equisetum arvense</i> L.	Equisetaceae		1	1	1	1
<i>Eremurus olgae</i> Regel	Asphodelaceae			1	1	
<i>Eremurus stenophyllus</i> subsp. <i>aurantiacus</i> (Baker) Wendelbo	Asphodelaceae			1	1	
<i>Eruca vesicaria</i> (L.) Cav.	Brassicaceae		1	1	1	
<i>Eupatorium cannabinum</i> L.	Asteraceae		1	1	1	
<i>Fagopyrum esculentum</i> Moench	Polygonaceae			1	1	1
<i>Ferula assa-foetida</i> L.	Apiaceae		1	1	1	1
<i>Ferula moschata</i> (H.Reinsch) Koso-Pol.	Apiaceae		1	1	1	
<i>Ficus carica</i> L.	Moraceae	1	1	1	1	1
<i>Foeniculum vulgare</i> Mill.	Apiaceae	1	1	1	1	1
<i>Fraxinus excelsior</i> L.	Oleaceae		1	1	1	
<i>Glaucium corniculatum</i> (L.) Curtis	Papaveraceae	1	1	1	1	
<i>Glycyrrhiza glabra</i> L.	Fabaceae	1	1	1	1	1
<i>Gossypium herbaceum</i> L.	Malvaceae	1	1	1	1	1
<i>Gratiola officinalis</i> L.	Plantaginaceae		1	1	1	1
<i>Haloxylon persicum</i> Bunge ex Boiss. & Buhse	Amaranthaceae			1		
<i>Hordeum distichon</i> L.	Poaceae			1		
<i>Hordeum vulgare</i> L.	Poaceae	1	1	1		
<i>Humulus lupulus</i> L.	Cannabaceae			1	1	1
<i>Hyacinthus orientalis</i> L.	Asparagaceae		1			
<i>Hyoscyamus niger</i> L.	Solanaceae	1	1	1	1	1
<i>Hypericum perforatum</i> L.	Hypericaceae		1	1	1	1
<i>Hyssopus officinalis</i> L.	Lamiaceae	1	1	1	1	
<i>Indigofera tinctoria</i> L.	Fabaceae		1	1	1	
<i>Inula helenium</i> L.	Asteraceae		1	1	1	1
<i>Isatis tinctoria</i> L.	Brassicaceae		1	1		
<i>Juglans regia</i> L.	Juglandaceae	1	1	1	1	1
<i>Lactuca sativa</i> L.	Asteraceae			1	1	
<i>Lactuca serriola</i> L.	Asteraceae	1	1	1	1	
<i>Lagenaria siceraria</i> (Molina) Standl.	Cucurbitaceae			1		
<i>Lathyrus oleraceus</i> Lam.	Leguminosae			1	1	
<i>Lemna minor</i> L.	Araceae		1	1	1	
<i>Lepidium campestre</i> (L.) W.T. Aiton	Brassicaceae			1		
<i>Lepidium latifolium</i> L.	Brassicaceae	1	1	1	1	
<i>Lepidium perfoliatum</i> L.	Brassicaceae		1	1	1	
<i>Lepidium sativum</i> L.	Brassicaceae	1	1	1		
<i>Leptaleum filifolium</i> (Willd.) DC.	Brassicaceae			1		
<i>Lilium candidum</i> L.	Liliaceae	1	1	1		
<i>Linum usitatissimum</i> L.	Linaceae	1	1	1	1	1
<i>Lithospermum officinale</i> L.	Boraginaceae			1	1	
<i>Lolium perenne</i> L.	Poaceae			1		
<i>Lolium temulentum</i> L.	Poaceae		1	1		
<i>Lysimachia arvensis</i> (L.) U. Manns & Anderb.	Primulaceae		1	1	1	
<i>Lysimachia vulgaris</i> L.	Primulaceae		1	1	1	
<i>Malus domestica</i> (Suckow) Borkh.	Rosaceae	1	1	1		
<i>Malva sylvestris</i> L.	Malvaceae	1		1	1	

Plant species	Family	Ar-Razi	Avicenna	Beruni	Use in medicine	
					Folk	Modern
<i>Marrubium vulgare</i> L.	Lamiaceae		1	1	1	
<i>Medicago sativa</i> L.	Fabaceae		1	1		
<i>Melia azedarach</i> L.	Meliaceae		1	1		
<i>Melilotus officinalis</i> (L.) Lam.	Fabaceae	1	1	1	1	1
<i>Mentha × piperita</i> L.	Lamiaceae		1	1	1	1
<i>Morus alba</i> L.	Moraceae		1	1	1	1
<i>Morus nigra</i> L.	Moraceae		1	1	1	1
<i>Narcissus poeticus</i> L.	Amaryllidaceae		1	1		
<i>Narcissus tazetta</i> L.	Amaryllidaceae		1	1		
<i>Nasturtium officinale</i> W.T. Aiton	Brassicaceae			1	1	
<i>Nepeta cataria</i> L.	Lamiaceae			1	1	
<i>Nerium oleander</i> L.	Apocynaceae		1	1		1
<i>Nigella sativa</i> L.	Ranunculaceae		1	1	1	
<i>Nuphar lutea</i> (L.) Sm.	Nymphaeaceae			1	1	1
<i>Nymphaea lutea</i> L.	Nymphaeaceae	1		1		
<i>Ocimum basilicum</i> L.	Lamiaceae	1	1	1	1	
<i>Ononis spinosa subsp. antiquorum</i> (L.) Briq.	Fabaceae			1	1	
<i>Onopordum acanthium</i> L.	Asteraceae		1	1	1	1
<i>Oryza sativa</i> L.	Poaceae		1	1		
<i>Oxalis corniculata</i> L.	Oxalidaceae			1		
<i>Panicum miliaceum</i> L.	Poaceae	1	1	1		
<i>Papaver somniferum</i> L.	Papaveraceae	1	1	1	1	1
<i>Pastinaca sativa</i> L.	Apiaceae		1	1		
<i>Peganum harmala</i> L.	Nitrariaceae		1	1	1	1
<i>Pentanema britannicum</i> (L.) D. Gut. Larr., Santos-Vicente,	Asteraceae			1	1	
<i>Persicaria hydropiper</i> (L.) Delarbre	Polygonaceae		1	1	1	1
<i>Petroselinum crispum</i> (Mill.) Nyman	Apiaceae		1	1	1	1
<i>Phaseolus vulgaris</i> L.	Fabaceae		1	1	1	1
<i>Phragmites australis</i> (Cav.) Trin. ex Steud.	Poaceae	1	1	1	1	
<i>Picnomon acarna</i> (L.) Cass.	Asteraceae		1	1	1	
<i>Pimpinella anisum</i> L.	Apiaceae	1	1	1	1	1
<i>Pistacia vera</i> L.	Anacardiaceae	1	1	1	1	1
<i>Plantago major</i> L.	Plantaginaceae		1	1	1	1
<i>Platanus orientalis</i> L.	Platanaceae		1	1		
<i>Polygonum aviculare</i> L.	Polygonaceae		1	1	1	1
<i>Populus alba</i> L.	Salicaceae		1			
<i>Populus nigra</i> L.	Salicaceae			1	1	
<i>Portulaca oleracea</i> L.	Portulacaceae	1	1	1	1	
<i>Potamogeton natans</i> L.	Potamogetonaceae		1	1	1	
<i>Potentilla reptans</i> L.	Rosaceae		1	1	1	
<i>Prunus armeniaca</i> L.	Rosaceae	1	1	1	1	1
<i>Prunus avium</i> (L.) L.	Rosaceae			1		
<i>Prunus cerasifera</i> Ehrh.	Rosaceae			1		
<i>Prunus cerasus</i> L.	Rosaceae			1	1	1
<i>Prunus davidiana</i> (Carrière) Franch.	Rosaceae	1	1	1	1	1
<i>Prunus domestica</i> L.	Rosaceae	1	1	1	1	1
<i>Prunus mahaleb</i> L.	Rosaceae		1	1	1	
<i>Prunus persica</i> (L.) Batsch	Rosaceae		1	1	1	
<i>Pseudohandelia umbellifera</i> (Boiss.) Tzvelev	Asteraceae		1	1		
<i>Punica granatum</i> L.	Lythraceae	1	1	1	1	1
<i>Pyrus communis</i> L.	Rosaceae	1	1	1	1	
<i>Raphanus raphanistrum</i> L.	Brassicaceae			1		
<i>Raphanus raphanistrum subsp. sativus</i> (L.) Domin	Brassicaceae	1	1	1		
<i>Rhamnus cathartica</i> L.	Rhamnaceae	1				
<i>Rheum palmatum</i> L.	Polygonaceae		1	1	1	1
<i>Rhus coriaria</i> L.	Anacardiaceae	1	1	1	1	1
<i>Ricinus communis</i> L.	Euphorbiaceae	1	1	1	1	1
<i>Ridolfia segetum</i> (L.) Moris	Apiaceae	1	1	1	1	1
<i>Rosa × damascena</i> Herrm.	Rosaceae		1	1	1	1
<i>Rosa alba</i> L.	Rosaceae			1	1	1

Plant species	Family	Ar-Razi	Avicenna	Beruni	Use in medicine	
					Folk	Modern
<i>Rosa canina</i> L.	Rosaceae		1	1	1	1
<i>Rubia tinctorum</i> Salisb.	Rubiaceae	1	1	1	1	1
<i>Rumex acetosa</i> L.	Polygonaceae	1	1	1	1	
<i>Ruta graveolens</i> L.	Rutaceae	1	1	1		
<i>Salix aegyptiaca</i> L.	Salicaceae		1	1		
<i>Salix alba</i> L.	Salicaceae			1		
<i>Salix babylonica</i> L.	Salicaceae		1	1		
<i>Salix caprea</i> L.	Salicaceae		1	1		
<i>Sambucus nigra</i> L.	Viburnaceae			1		
<i>Senna alexandrina</i> Mill.	Fabaceae		1	1	1	1
<i>Senna alexandrina</i> var. <i>alexandrina</i>	Fabaceae	1	1	1	1	1
<i>Senna italica</i> Mill.	Fabaceae		1	1	1	1
<i>Sesamum indicum</i> L.	Pedaliaceae	1	1	1	1	1
<i>Silybum marianum</i> (L.) Gaertn.	Asteraceae		1	1		1
<i>Sinapis alba</i> L.	Brassicaceae		1	1	1	
<i>Sinapis arvensis</i> L.	Brassicaceae			1		
<i>Sium sisarum</i> L.	Apiaceae		1	1		
<i>Solanum melongena</i> L.	Solanaceae		1	1		
<i>Solanum nigrum</i> L.	Solanaceae	1	1	1	1	
<i>Sonchus oleraceus</i> L.	Asteraceae			1		
<i>Sorghum bicolor</i> (L.) Moench	Poaceae			1	1	
<i>Spartium junceum</i> L.	Fabaceae		1	1		
<i>Spinacia oleracea</i> L.	Amaranthaceae	1	1		1	
<i>Tamarix gallica</i> L.	Tamaricaceae	1				
<i>Tanacetum parthenium</i> (L.) Sch. Bip.	Asteraceae		1	1	1	
<i>Tanacetum parthenium</i> (L.) Sch. Bip.	Asteraceae			1		
<i>Taraxacum officinale</i> F.H. Wigg.	Asteraceae		1	1	1	1
<i>Taxus baccata</i> L.	Taxaceae		1	1		
<i>Thymus serpyllum</i> L.	Lamiaceae		1	1	1	1
<i>Trachyspermum ammi</i> (L.) Sprague	Apiaceae			1	1	
<i>Tribulus terrestris</i> L.	Zygophyllaceae	1	1	1	1	1
<i>Trifolium fragiferum</i> L.	Fabaceae			1	1	
<i>Trifolium pratense</i> L.	Fabaceae		1			
<i>Trigonella foenum-graecum</i> L.	Fabaceae	1	1	1	1	
<i>Triticum aestivum</i> L.	Poaceae	1	1	1	1	
<i>Tussilago farfara</i> L.	Asteraceae		1	1	1	1
<i>Typha latifolia</i> L.	Typhaceae		1	1	1	
<i>Ulmus minor</i> Mill.	Ulmaceae			1		
<i>Urtica dioica</i> L.	Urticaceae	1	1	1	1	1
<i>Verbascum songaricum</i> Schrenk	Scrophulariaceae		1	1	1	1
<i>Verbena officinalis</i> L.	Verbenaceae		1	1	1	
<i>Vicia ervilia</i> Willd.	Fabaceae	1	1	1		
<i>Vicia faba</i> L.	Fabaceae	1	1	1		
<i>Vicia lens</i> (L.) Coss. & Germ.	Fabaceae	1	1	1	1	
<i>Vicia sativa</i> L.	Fabaceae		1	1		
<i>Viola odorata</i> L.	Violaceae	1		1	1	
<i>Vitex agnus-castus</i> L.	Lamiaceae		1	1	1	
<i>Vitis vinifera</i> L.	Vitaceae	1	1	1	1	1
<i>Ziziphus jujuba</i> Mill.	Rhamnaceae		1	1	1	
Total		87	182	231	173	86

Medicinal herbs mostly belong to the families of Asteraceae, Fabaceae, Rosaceae, Brassicaceae, Apiaceae, Poaceae and other (Fig. 2).

Our analysis of the references showed that *Prunus* (8 species), *Brassica* (4), *Lepidium* (4), *Rosa* (3), *Salix* (4), *Vicia* (4), *Allium* (3), *Amaranthus* (3), *Artemisia* (3), *Cucumis* (3), and *Senna* (3) were the dominant medicinally used plant genera. Let us consider in more detail the genus *Prunus*, which is most of the species in this genus (Table 3).

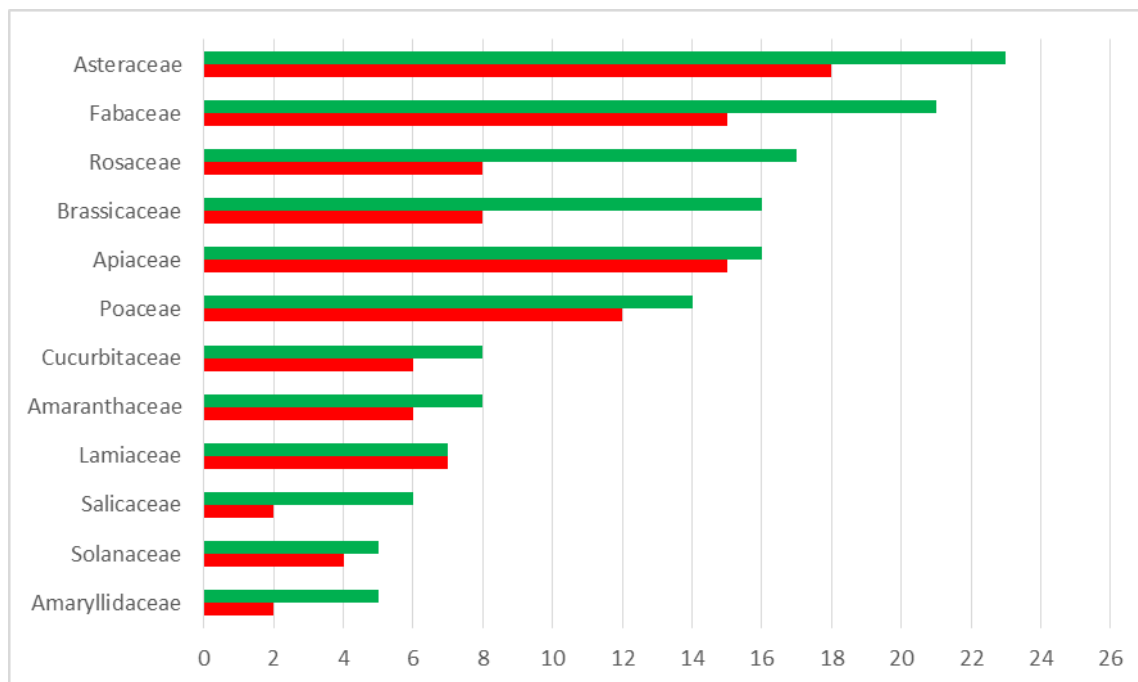


Figure 2. Number of genera (red) and species (green) in the ten most cited plant families.

Nowadays, among the plants used and cited in the writings of the named scientists of the Middle East, more than 50 species of plants are included in official herbal medicine directories (Muravyova 1964; Wolf, Maleeva 1969; Sokolov, Zamotaev 1984) and pharmacopeias (Obomaikova, Arzamastsev 1968). These are the following taxa: *Acorus calamus* L., *Aloe vera* L., *Pimpinella anisum* L., *Althaea officinalis* L., *Artemisia absinthium* L., *A. cina* O. Berg., *A. vulgaris* L., *Calendula officinalis* L., *Senna alexandrina* Mill., *Citrullus colocynthis* (L.) Schrad., *Commiphora kua* (R.Br. ex Royle) Vollesen, *Crataegus sanguinea* Pall., *Datura stramonium* L., *Drimia maritima* (L.) Stearn, *Dryopteris filix-mas* (L.) Schott, *Equisetum arvense* L., *Euphorbia resinifera* O. Berg, *Hyoscyamus niger* L., *Hypericum perforatum* L., *Inula helenium* L., *Juniperus communis* L., *Glycyrrhiza glabra* L., *Linum usitatissimum* L., *Matricaria chamomilla* L., *Melilotus officinalis* (L.) Lam., *Mentha × piperita* L., *Origanum vulgare* L., *Papaver somniferum* L., *Persicaria hydropiper* (L.) Delarbre, *Peganum harmala* L., *Prunus amygdalus* Batsch, *Punica granatum* L., *Quercus robur* L., *Rhamnus cathartica* L., *Rheum officinale* Baill., *R. palmatum* L., *Ricinus communis* L., *Rosa beggeriana* Schrenk, *R. fedtschenkoana* Regel, *Salvia officinalis* L., *Sinapis alba* L., *Thymus serpyllum* L., *Tussilago farfara* L., *Trachyspermum ammi* (L.) Sprague, *Taraxacum officinale* F.H. Wigg., *Urtica dioica* L., *Vachellia nilotica* subsp. *tomentosa* (Benth.) Kyal. & Boatwr., *Valeriana officinalis* L. and others.

According to Khalmatov (Khalmatov 1958, 1984, 1999) and (Khojimatov et al. 1995), the number of medicinal plants in the flora of Uzbekistan exceeds 1157 species, and by the definition of Khojimatov (Khojimatov 2021), their number is even more than 1200. According to the results of our study, among the medicinal plants currently used in folk and scientific medicine, more than 240 species were cited in the works of Ar-Razi, Avicenna, Beruni, and Yusufi. In this article we only provide Avicenna data on some of the medicinal plants of Uzbekistan currently often used in folk medicine.

Acorus calamus L. - plant juice applied as a diuretic and for gastrointestinal pain. In folk medicine, infusion from rhizomes is used as a tonic and expectorant for coughing and chest pains.

Althaea officinalis L. - decoction from roots, seeds and leaves was recommended for inflammation of the lungs, pleurisy and as an expectorant. In folk medicine, roots, leaves, and flowers are used for coughing and chest pains

Artemisia spp. - recommended a bath from the aboveground part of wormwood in the treatment of renal stone disease. He used a decoction of the herb for the common cold and as a biliary and diuretic biliary. In folk medicine, flower decoction is used as biliary, sweating, clay and antipyretic.

Glycyrrhiza glabra L. - Avicenna used the roots of the plant for kidney ulcers and inflammation of the stomach, fever, and pulmonary diseases. In folk medicine, decoction and root extract are used as sweating and laxative agents.

Hyoscyamus niger L. - squeezed leaf juice in the ear, eye, and dental pain. In folk medicine, a leaf patch is applied to draw pus and used as an analgesic.

Table 3. Selected list of economically important and medicinal plant species used in folk and modern medicine.

Scientific name	Local name	Parts used	Used to folk medicine	Used for
<i>Prunus avium</i> (L.) L.	Gilos	Fruits, fruit stalks	Cherry juice is used as an expectorant for bronchitis and tracheitis, an aqueous infusion of fruit pulp is a refreshing and antipyretic agent for colds	The plant emits a lot of gum, which is used in textile production and in the finishing of fabrics. The bark contains 7-10% tannins, which allows it to be used for tanning leather. Bark and roots used to be used for dyeing wool and fabrics. The wood is suitable for joinery, hoops are made from young trunks. Cherry pipes and mouthpieces are well-known. Melliferous.
<i>Prunus cerasus</i> L.	Olcha	Fruits, fruit stalks, bark	The influence of cherries and cherry juice on the heart and blood vessels is known. Vitamin PP together with ascorbic acid has a positive effect on blood vessels, increasing their permeability. And the coumarins in the berry are involved in regulating the clotting process, preventing the formation of blood clots and thinning the blood.	Food, melliferous, technical, decorative. Used in cosmetology.
<i>Prunus cerasifera</i> Ehrh.	Togolcha	Flowers, leaves, fruits	Cherry plum leaves are often used because of the high content of active ingredients in them and the possibility of long-term storage. The leaves are added to herbal mixtures - collections and herbal teas, and they are also brewed on their own for the following diseases: coughs, colds; vitamin deficiency, anemia; as diaphoretic, cleansing agent; diseases of the gastrointestinal tract; diseases of the kidneys and liver; impotence Tea made from cherry plum leaves is recommended to be included in their diet for pregnant and lactating women, as well as for older people and children, since cherry plum is simply an irreplaceable vitamin remedy in the autumn-winter period. The infusion of cherry plum leaves has a relaxing and calming effect on humans. It has a very beneficial effect on the functioning of the central nervous system. Helps with stress. Cherry plum is also an excellent laxative and anti-scung agent.	Food, melliferous, technical, decorative.
<i>Prunus domestica</i> L.	Olcha	Flowers, leaves, fruits, bark	Dried plum fruits, which, due to their high fiber content, are able to enhance intestinal motility. Due to the presence of pectins, plums have the ability to remove radionuclides from the body. The fruits of the plant are popularly used in the treatment of anemia, hypertension, rheumatism, chronic constipation, diseases of the organs of the excretory system. Freshly squeezed plum juice is also a dietary product that improves the functioning of the gastrointestinal tract.	Food, melliferous, ornamental. Fatty oil from plum seeds, obtained by cold pressing, is used for pharmaceutical and cosmetic purposes along with almond oil. Plum fruits are widely used in food, confectionery and alcoholic beverage industries.
<i>Prunus persica</i> (L.) Batsch	Shaftoli	Flowers, leaves, fruits, bark	Peach fruits are prescribed for dietary nutrition of patients with anemia, heart disease, as a diuretic, adaptogenic agent. Peaches, due to the presence of phenolic compounds, flavonoids, have antioxidant properties, especially the peel of the fruit. The bark of the peach tree prevents the development of benign prostatic hyperplasia.	Peach seed oil is used as a solvent for medicinal substances, along with plum and apricot seed oil.

Inula helenium L. - used grass for inflammation of the sciatic nerve, for joint pains, and root syrup as a diuretic. In folk medicine, infusion and decoction from roots are used as an expectorant, diuretic, antipyretic agent.

Punica granatum L. - flowers were used to treat gastric diseases, bleeding gums, and fruits as a diuretic and astringent agent in gastric diseases. In ethnomedicine, it is used as a painkiller, a clay agent, as well as in scabies, jaundice, and intestinal infections.

Trachyspermum copticum Link. - Avicenna recommended an infusion of fruits as a diuretic, to cleanse the kidneys and urinary bladder. In folk medicine, it is used as a clay and gastric agent.

Tussilago farfara L. - used as an expectorant for coughing, fresh leaf juice - as a biliary and diuretic. In ethnomedicine, they are used for the same diseases.

Taraxacum officinale F.H. Wigg. - juice from fresh leaves was recommended for watering and blockage of the liver. In folk medicine, fresh leaf juice is recommended for chest pains and as a laxative.

The use of medicinal fungi

Considering the total estimated number of fungal species (about 5.1 million), it is no surprise that among them are species that produce important compounds (e.g., penicillin) that form the basis of several classes of medicinal products, such as antibiotics and immune enhancers, as well as some species that are a danger to human health (e.g., *Aspergillus* and *Candida* species).

Mushrooms, such as reishi (also known as ling zhi; *Ganoderma lucidum*, Ganodermataceae), have been used medicinally in Asia for centuries (Wasser 2005; McMeekin 2005). Complementing this rich history of use, numerous scientific studies have been performed on mushroom extracts for their potential health benefits. Many fungi contain a rich enzyme kit and physiologically active substances. These properties are widely used by humans. The discovery of antibiotics is one of the recent achievements. Penicillin, a product of the life of *Penicillium* fungi, was widely used in Medicine. Using the fungus *Aspergillus niger*, citric acid is obtained, gibberellin from the marsupial stage of *Gibberella fujikuroi* is used as a growth substance (Brain *et al.* 1954). It is well known that some species of fungi are widely used by the population as food and therefore even they are specially bred. Although the mycobiota of the Central Asian region have been explored by different mycologists since the 20th century, the diversity of fungi there have largely been neglected, resulting in a very fragmentary knowledge of this resource in the region (Gafforov 2017; Gafforov and Rakhimova 2017; Gafforov *et al.* 2016, 2017, 2019; Cheek *et al.* 2020; Abdurazakov *et al.* 2021; Wang *et al.* 2021; Lestari *et al.* 2021; Htet *et al.* 2021). In Uzbekistan, medicinal and edible fungi are particularly poorly studied and not exploited at all (Gafforov 2014; Yatsiuk *et al.* 2016; Gafforov *et al.* 2020, Wang *et al.* 2021).

In the East, mushrooms have been known as a medicine for centuries. In the works of Ar-Razi (Clinical records of Abu Bakr Razii 1994; Ar-Razi 1994), Avicenna (Ibn Sina 1996) and Beruni (Beruni 1973), both the benefit and the harm of mushrooms are mentioned. For example:

Some biological organisms have been mentioned by the Holy Qura'n and Sahih al-Bukhari, including mushrooms such as truffles and are known under the names "Kama'ah" and "Fagaa" in Arabic (Khalifa *et al.* 2019). Taxonomically, truffles are ascomycetes fungi belonging to several genera in six Glaziellaceae, Discinaceae, Morchellaceae, Helvellaceae, Tuberales, Pezizaceae, and Pyronemataceae families. Such as one of important edible and medicinal genus *Tuber*, the family Tuberales, and the order Pezizales, contains at least ca. 230 species worldwide, associated with ectomycorrhizal forms and the roots of a broad range of both gymnosperm and angiosperm hosts spread over the temperate forests, flood plains, and subtropical forests habitats (O'Donnell *et al.* 1997; Benucci *et al.* 2011, 2012a, 2012b). Truffle is highly appreciated as a dietary component and nutritional substitute and the great consumption is owned to its high aroma taste and musky flavor (Al-Laith 2010; Dahham *et al.* 2018; Feng *et al.* 2019; Mustafa *et al.* 2020). Furthermore, truffle oil, used in different types of salads, contains a broad range of volatile organic compounds (Wernig *et al.* 2018). Truffles are enriched in a wide range of bioactive chemical constituents such as anthocyanins, oligosaccharides, flavonoids, carotenoids, pheromones, and steroids. In addition to being used as food all over the world, truffles are also valued as therapeutic agents with antioxidant, anti-mutagenic, anticarcinogenic, anti-microbial, anti-viral, immune-modulating, anti-inflammatory, anti-depressant (El Enshasy *et al.*, 2013). With the high price and rarity of truffle fungi, they are highly vulnerable to fraud, as in the case of *Tuber melanosporum*, the "black truffle", which is referred to as the black diamond of cuisine and is considered one of the most culinary and commercially valued species of truffles. (Feng *et al.* 2019; Mustafa *et al.* 2020). *Tuber melanosporum* (called "Al-Kamaa" or "Al-Fag'a" or "Kama" in Arabic), is given that the best sandy, white, they must be boiled in water with salt, peeled and cut in half, boiled in olive oil with spices and gum stink ferules (*Ferula assa-foetida* L.). When poisoned with it, you need to take pure wine with spices. Mushrooms cause paralysis of the joint,

and "sacta" disease (apoplection) and make urination difficult. Avicenna described the truffles as a cure in the 10th century, for a variety of disorders like vomiting, wounds, and weakness. In one of his famous books namely the "Al-Qanun fi't-Tibb" (The Canon of Medicine) written in the tenth century as part of the Arabian Traditional Medicine. It was used as a medical textbook in the Islamic world and Europe up to the 18th century. Avicenna recommended desert truffle juice used for common eye inflammations.

Curly ("Gushna," "Futr"), or *Morchella esculenta* shrivels like cartilage, its shape is like a small, shriveled cup. They wash their dress and eat with sour condiments. By Beruni, the curly ("Gushana") is also mentioned as a laundry detergent. When dried, the curls become white and inside red. They are put in an antimony vessel, they have the color of dust with a black tint and are a medicine for the eyes, applying such an ointment with a stick. Morels, a group of the world's highly valued edible and medicinal mushrooms, are of very important economic and scientific value. Most morel mushrooms contain a wide range of active constituents which include tocopherols, carotenoids, organic acids, polysaccharides, and phenolic compounds which exhibit a wide range of medicinal and pharmacological properties including anti-microbial, anti-inflammatory, immunostimulatory, antitumor, and antioxidant (Du *et al.* 2015; Liu *et al.* 2018). It is also used for the treatment of indigestion, excessive phlegm, and asthma (Tietel *et al.* 2018).

Agarikon or Gharikon and scientific name is *Fomitopsis officinalis* (Vill.) Bondartsev & Singer in appearance "dense, like wood, yellow, smooth in the places of breaking, sweet in taste, means good." This species is commonly known as the Agarikon or Gharikon mushroom in Iran (Vazirian *et al.*, 2016). *Fomitopsis officinalis* is a wood-rotting fungus that found on various conifer trees. The fungus is native to Europe, Asia, and North America. Agarikon has been in use for thousands of years due to its healing potential and it was originally found by Greek physician Dioscorides Pedanios in the 1st century AD. This fungal species is a treatment against consumption illnesses such as pulmonary tuberculosis. The basidiome of Agarikon has also been carved to make masks used by Native Indians used during rituals, indicating the size of this mushroom. In modern medicine, *Fomitopsis officinalis* used as a source of an antibacterial, antifungal, antiviral, anti-inflammatory well as and immunostimulant and antitumor agents (Lindequist *et al.* 1990; Blagodatsji *et al.* 2018; Elkhateeb *et al.* 2019).

Some other species of truffles (in Arabic "Facwat-dabu," "Bondage") are like a stick with a head. They are boiled when the mushrooms dry and bear fruit, or at the very beginning of growth. In the paragraphs on fungi, Beruni, referring to the work of other authors, leads to the benefit and harm of mushrooms: for example, Indian troops who welded and ate harmful mushrooms were poisoned, resulting in the death of 13 people. The species of fungi, called "Nulita" (i.e., *Boletus*) was considered the best, and other "Amanita," on the contrary, are dangerous to life. On killing mushrooms there is sticky moisture, after collection, they quickly rot and spoil. In the paragraph "Futr" (mushrooms) there are references to Dioscorides and Galen, which also indicated the benefit and harm of mushrooms.

Medieval sources also state that mushrooms that appear in the vipers and snake's nests or grow under olive (*Olea europaea* L.) and in places where there is the dung of donkeys and other horse-like animals are called "snake mushrooms," because they are deadly toxic.

This data, written almost 1000 years ago, has not lost significance to this day. The people of Central Asia have long distinguished edible and harmful mushrooms when used.

Conclusion

The science of medicine in the ancient East has a deep connection to the founders of the Greek medical school, e.g., Hippocrates, Aristotle, Dioscorides, Galen, etc. Greek folk medicine was later adopted in the East - in Syria and Persia. There was even a medical school in Persia, where ancient Greek books on medicine were translated into Arabic. Scientists-physicians of the medieval East like Razi, Avicenna, Beruniy and others also belonged to that school. The Arabian pharmacopeia widely used complex recipes, which contained various herbs. In Arab countries, special books ("Karabadins") describing the methods of preparation and consumption of medicines were written. Later these books were then translated in neighboring Muslim states and Europe. It should be noted that the comprehensive medieval knowledge still will provide an opportunity to discover new medicinal plants and remedies, as well as help to introduce them into practical medicine. We will continue this work in the future and provide more information on the use of medicinal plants and fungi in folk and modern medicine.

A book of Ar-Razi, "Clinical Records of Abu Bakr Razi and His Disciple," describes the histories of more than 750 diseases and methods of treating them with medicinal herbs. About 173 medicinal plants used by Ar-Razi were mentioned more than a century later in the writings of Avicenna and Beruni. The book of "The Canon of Medicine" (Al-Konun) written by Avicenna consists of 5 volumes. The drugs are mainly described in the second volume "Medicinal Plants" which contains about 515 plants names. In Beruni's book of Saydana (Kitab as-Saidana fit-tib), the names of 901 medicinal plants, 107 minerals, and 101 animal products are given in different languages. Beruni was one of the first to compile a dictionary of medicinal plants, citing the names of medicines in various languages of the East at that time, including Central Asia. Yusufi, Quatrains (Rubayat), described the healing properties of more than 110 plants and the methods of preparation of medicines.

In conclusion, this study provides the first list of medicinal plants and some fungi with new names of plant species and other ethnobotanical information from the medieval east. These species are economically important as sources of food and medicines. Beyond local scale, these data are also crucial as a supplement of the worldwide knowledge of ethnobiology for elucidating folk and scientific medicine.

Declarations

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Literature Cited

Abu Ali Ibn Sino. Canon of Medicine. 1996. Tashkent: Vol. 2. 336 p.

Abu Bakr Ar-Razi. Clinical records. 1994. Tashkent: 251. (In Uzbek)

Abu Bakr Razii, Clinical records of Abu Bakr Razii, his student. 1973 Fan Publishing House. 335. (in Uzbek).

Abu Raikhan Beruni. Selected works, V. 4. 1973. Fan Publishing House. 1120. (in Russian)

Al-Laith AAA. 2010. Antioxidant components and antioxidant/antiradical activities of desert truffle (*Tirmania nivea*) from various Middle Eastern origins. Journal of Food Composition and Analysis 23:15-22. doi: 10.1016/J.JFCA.2009.07.005

Amjad MS, Arshad M, Qureshi R. 2015. Ethnomedicinal inventory and folk uses of indigenous plants from Pir Nasoora National Park, Azad Jammu and Kashmir. Asian Pac J Trop Biomed 5:234–41.

Angiosperm Phylogeny Group 2016. An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG IV. Botanical Journal of the Linnean Society 181(1):1-20, doi:10.1111/boj.12385.

Arzumetov YS, Yuldashev KY 1983. Ibn Sino's medical views. Tashkent: Medicine Publishing House. 120

Azaizeh H, Saad B, Khalil K, Said O. 2006. The state of the art of traditional arab herbal medicine in the eastern region of the Mediterranean: a review. Evidence-Based Complementary and Alternative Medicine 3(2):229-35. doi: 10.1093/ecam/nel034.

- Benucci GMN, Bonito G, Falini L, Bencivenga M. 2012b. Mycorrhization of Pecan trees (*Carya illinoensis*) with commercial truffle species: *Tuber aestivum* Vittad and *Tuber borchii* Vittad. *Mycorrhiza* 22:383-392. doi: 10.1007/s00572-011-0413-z
- Benucci GMN, Gogan Csorbai A, Di Massimo G, Baciarelli Falini L, Bencivenga M, Donnini D. 2012a. Mycorrhization of *Quercus robur* L. and *Corylus avellana* L. seedlings with *Tuber macrosporium* Vittad. *Mycorrhiza*. doi: 10.1007/s00572-012-0441-3
- Benucci GMN, Raggi L, Albertini E, Grebenc T, Bencivenga M, Falcinelli M, Di Massimo G. 2011. Ectomycorrhizal communities in a productive *Tuber aestivum* Vittad. orchard: composition, host influence and species replacement. *FEMS Microbiology Ecology* 76(1):170-184. doi: 10.1111/j.1574-6941.2010.01039.x
- Blagodatski A, Yatsunskaya M, Mikhailova V, Tiasto V, Kagansky A, Katanaev VL. 2018. Medicinal mushrooms as an attractive new source of natural compounds for future cancer therapy. *Oncotarget* 9:29259-29274. doi: 10.18632/oncotarget.25660
- Brian PW, Elson GW, Hemming HG, Radley M. 1954. The plant-growth-promoting properties of gibberellic acid, a metabolic product of the fungus gibberella fujikuroi. *Journal of the Science of Food and Agriculture* 5(12):602-612. doi: 10.1002/jsfa.2740051210.
- Burghart DL, Sabonis-Helf T (eds). 2018. *Central Asia in the era of sovereignty: the return of Tamerlane?* Lanham, Lexington Books, p. 521.
- Cheek M, Nic Lughadha E, Kirk P, Lindon H, Carretero J, Looney B, Douglas B, Haelewaters ID, Gaya E, Llewellyn T. et al. 2020. New discoveries: Plants and Fungi. *Plants, People, Planet* 2:371-388. doi: 10.1002/ppp3.10148
- Cherepanov SK. 1995. *Vascular Plants of the USSR*. Sanct Petersburg, Mir i semiya Publishing House, 992 (In Russian).
- Dahhama SS, Al-Rawia SS, Ibrahim AH, Abdul Majid AS, Abdul Majida AMS. 2018. Antioxidant, anticancer, apoptosis properties and chemical composition of black truffle *Terfezia claveryi*. *Saudi Journal of Biological Sciences* 25(8):1524-1534. doi: 10.1016/j.sjbs.2016.01.031
- Du XH, Zhao Q, Yang ZL. 2015. A review on research advances, issues, and perspectives of morels. *Mycology* 96(2):78-85. doi: 10.1080/21501203.2015.1016561
- El Enshasy H, Elsayed EA, Aziz R, Wadaan MA. 2013. Mushrooms and Truffles: Historical Biofactories for Complementary Medicine in Africa and in the Middle East. *Evidence-Based Complementary and Alternative Medicine* 2013:620451. doi: 10.1155/2013/620451
- Elkhateeba WA, Dabaa GM, Elnahasa MO, Thomasb PW. 2019. *Fomitopsis officinalis* mushroom: ancient gold mine of functional components and biological activities for modern medicine. *Egyptian Pharmaceutical Journal* 18(4):285-289. doi: 10.4103/epj.epj_46_19
- Feng T, Shui M, Song S, Zhuang H, Sun M, Yao L. 2019. Characterization of the Key Aroma Compounds in Three True Varieties from China by Flavoromics Approach. *Molecules* 24(18):3305. doi: 10.3390/molecules24183305
- Flora of Uzbekistan. 1941-1962. Vol. 1-6. Fan Publishing House.
- Gafforov Y, Abdurazzokov A, Yarasheva M, Ono Y. 2016. Rust fungi from the Fergana Valley, Chatkal and Kurama Mountain Ranges in Uzbekistan. *Staphia Reports* 105:161-175.
- Gafforov Y, Ordynets A, Langer E, Yarasheva M, Gugliotta AM, Schigel D, Pecoraro L, Zhou Y, Cai L, Zhou LW. 2020. Species diversity with comprehensive annotations of woodinhabiting poroid and corticioid fungi in Uzbekistan. *Frontiers in Microbiology* 11:598321. doi: 10.3389/fmicb.2020.598321
- Gafforov Y, Phookamsak R, Jiang HB, Wanasinghed DN, Juliev M. 2019. *Ophiobolus hydei* sp. nov. (Phaeosphaeriaceae, Ascomycota) from *Cirsium* and *Phlomooides* in Uzbekistan. *Botany* 97:671-680. doi: 10.1139/cjb-2019-0118
- Gafforov Y, Rakhimov D. 2017. *Diplodia* and *Dothiorella* species (Botryosphaeriaceae, Ascomycota) from Uzbekistan. *Journal of the Botanical Research Institute of Texas* 11(2):455-467.
- Gafforov Y, Riebesehl J, Ordynets A, Langer E, Yarasheva M, Ghobad-Nejhad M, Zhou LW, Wang XW, Gugliotta AM. 2017. *Hyphodontia* (Hymenochaetales, Basidiomycota) and similar taxa from Central Asia. *Botany* 95:1041-1056. doi: 10.1139/cjb-2017-0115

- Gafforov Y. 2017. A preliminary checklist of ascomycetous microfungi from Southern Uzbekistan. *Mycosphere* 8(4):660-696. doi: 10.5943/mycosphere/8/4/12
- Howes MJ, Quave CL, Collemare J, Tatsis EC, Twilley D, Lulekal E, Farlow A, Li L, Cazar ME, Leaman D J, Prescott TAK, Milliken W, Martin C, De Canha MN, Lall N, Qin H, Walker BE, Vásquez-Londoño C, Allkin B, et al. 2020. Molecules from nature: Reconciling biodiversity conservation and global healthcare imperatives for sustainable use of medicinal plants and fungi. *Plants, People, Planet* 2: 463–481. doi.org/10.1002/ppp3.10138
- Htet ZH, Mapook A, Gafforov Y, Chethana KWT, Lumyoung S, Hyde KD. 2021. Molecular phylogeny and diversity of *Laburnicola* (Didymosphaeriaceae): a new species from Uzbekistan. *Phytotaxa* 527 (3):177-190. doi.org/10.11646/phytotaxa.527.3.2
- Index Fungorum. <http://indexfungorum.org/> (accessed: 04.10.2021)
- Iwu MM. 1994. African medicinal plants in the search for new drugs based on ethnomedicinal leads. In: Chadwick DJ, Marsh J, editors. *Ethnobotany and the search for new drugs*, Ciba foundation symposium 185. Chichester: Wiley; 116–29.
- Karimov Ul. 1973. Manuscript "Saidana" and the history of its study. Beruni. Selected works. V.4. Tashkent, 13-34.
- Keys to plants of Central Asia. Tashkent: Fan. 1968-1993. T. 1-10.
- Khalifaa SAM, Farag MA, Yosrie N, Sabirf JSM, Saeedh A, Al-Mousawii SM, Tahaj W, Musharraf SG, Patell S, El-Seedi HR. 2019. Truffles: From Islamic culture to chemistry, pharmacology, and food trends in recent times. *Trends in Food Science & Technology* 91:193-218. doi: 10.1016/j.tifs.2019.07.008
- Khalmatov KhKh. 1958. To the study of medicinal plants described in the "Canon" of Abu Ali Ibn Sina (1st communication). *Medicine Journal of Uzbekistan* 7:65-72.
- Khalmatov KhKh. 1999. Problems of systematization of plants, given in the "Canon of Medicine" by Ibn Sino. *Chemistry and Pharmacognosy* 6:10-14.
- Khasani M. 1992. Attending physician Babur-Yusufi. Translation and commentary by M. Khasani. Fan Publishing House. 190. (in Uzbek)
- Khojimatov Kh.Kh., Aprasidi GS, Khojimatov OK. 1995. Wild medicinal plants of Central Asia. Abu Ali Ibn Sina Publishing House. 112.
- Khojimatov O, Shagiakhmetova G, Shulgina N. 2018. Sixth National Report of the Republic of Uzbekistan on the conservation of biological diversity. United Nations Development Programme (UNDP). UNDP National Report No 6, 207. Kholmatov Kh.Kh. 1984. Wild medicinal plants of Uzbekistan. Medicine Publishing House. 277. (in Uzbek).
- Khojimatov OK, Khamraeva DT, Khujanov AN, Bussmann RW. 2020. An overview of Ethnomedicinal plants of Uzbekistan. *Ethnobotany Research & Applications* 20:08; doi.org/10.32859/era.20.08.1-19.
- Khojimatov OK. 2021. Medicinal plants of Uzbekistan (properties, application and rational use). Manaviyat Publishing House. 328. (in Russian).
- Kuchkarov B, Sherimbetov K, Aripdzhanov M, Gabitova R, Mitropolskaya J, Sobirov U, Talskikh V,
- Lestari AS, Wanasinghe DN, Gafforov Y, Tennakoon DS, Chethana KWT, Aburazakov A, Promputtha I, Hyde KD. 2021. Taxonomy and phylogenetic appraisal of *Leptosphaeria chatkalica* sp. nov. (Leptosphaeriaceae, Pleosporales) from Uzbekistan. *Phytotaxa*. 520(2). doi: 10.11646/phytotaxa.520.2.3. 155-168
- Lindequist U, Teuscher E, Narbe G. 1990. New active ingredients from Basidiomycetes. *Rational Phytotherapy* 11:139-149.
- Liu Q, Ma H, Zhang Y, Dong C. 2018. Artificial cultivation of true morels: current state, issues and perspectives. *Critical Reviews in Biotechnology* 38(2):259-271. doi: 10.1080/07388551.2017.1333082.
- Lubin N. 1984. Labour and Nationality in Soviet Central Asia: An Uneasy Compromise. Palgrave Macmillan. 305. <https://doi.org/10.1007/978-1-349-07204-0>
- Malik ZA, Bhat JA, Ballabha R, Bussmann RW, Bhatt AB. 2015. Ethnomedicinal plants traditionally used in health care practices by inhabitants of Western Himalaya. *Journal of Ethnopharmacology* 172:133-144.

- McMeekin D. 2005. The perception of *Ganoderma lucidum* in Chinese and Western culture. *Mycologist* 18:165-169. doi: 10.1017/S0269-915X(04)00406-9
- Muravyova DA. 1964. Tropical medicinal plants. Medicine Publishing House. 462. (in Russian).
- Mustafa AM, Angeloni S, Nzekoue FK, Abouelenein D, Sagratini G, Caprioli G, Torregiani E. 2020. An Overview on Truffle Aroma and Main Volatile Compounds. *Molecules* 25:5948; doi:10.3390/molecules25245948
- O'Donnell K, Cigelnik E, Weber NS, Trappe JM. 1997. Phylogenetic relationships among ascomycetons truffles and the true and false morels inferred from 18S and 28S ribosomal DNA sequence analysis. *Mycologia* 89(1):48-65.
- Obomaikova AN, Arzamastsev AP. (ed.) 1968. State Pharmacopoeia of the USSR. Medicine Publishing House. 1078 (in Russian).
- Plants of the World Online. <http://www.plantsoftheworldonline.org/> (accessed 07.09.2021).
- Raj AJ, Biswakarma S, Pala NA, Shukla G, Kumar M, Sumit Chakravarty S, Bussmann RW. 2018. Indigenous uses of ethnomedicinal plants among forest-dependent communities of Northern Bengal, India. *Journal of Ethnobiology and Ethnomedicine* 14:8.
- Ramalingum N, Mahomoodally MF. The therapeutic potential of medicinal foods. 2014. *Advances in Pharmacological Sciences* 2014; 2014:354264. doi:10.1155/2014/354264
- Sobirov RR, Kholmatov KhKh, Sobirov RS. 1993. Beruniy Shifobakhsh Giyohlar Khakida. *Urganch*. 40. (in Uzbek).
- Sokolov SY, Zamotaev IP. 1984. Handbook of Medicinal Plants, Medicine Publishing House, 462. (in Russian).
- Souza EN, Williamson EM, Hawkins JA. 2018. Which plants used in ethnomedicine are characterized? Phylogenetic patterns in traditional use related to research effort. *Frontiers in plant science* 9:834.
- Taizhanov K, Kholmatov KhKh, Zhabborov A. 2003. Ar-Roziy foydalangan dorivor usimliklarning monavii tizimi. *Kimyo va farmatsiya* 2:10-14. (in Uzbek).
- Taizhanov K, Taizhanova M. 2009. Taxonomic analysis of medicinal plants used in the Middle Ages East. *Uzbek Biological Journal* 6:43-47. (in Uzbek).
- Tietel Z, Masaphy S. 2018. True morels (*Morchella*)-nutritional and phytochemical composition, health benefits and flavor: A review. *Critical reviews in Food Science and Nutrition* 58(11):1888-1901. doi: 10.1080/10408398.2017.1285269.
- Tkachenko KG, Lebedeva TP. 2018. Ethnobotany in the modern world. Overview. *Proceedings of Voronezh State University. Series: Chemistry. Biology. Pharmacy* 2:172-184
- Toyzhanov K, Kholmatov KhKh. 1998. Yusufiy Kullagan Dorivor Usimliklar. *Kimyova Pharmacy*. 2:22-25. (in Uzbek).
- Vazirian M, Faridfar S, Eftekhari M. 2016. "Gharikon"/"Agharikon" a Valuable Medicinal Mushroom in Iranian Traditional Medicine. *Iranian Journal of Medical Sciences* 41(3):34.
- Wang XW, Jiang JH, Liu SL, Gafforov Y, and Zhou LW. 2021. Species diversification of the coniferous pathogenic fungal genus *Coniferiporia* (Hymenochaetales, Basidiomycota) in association with its biogeography and host plants. *Phytopathology*. doi: 10.1094/PHYTO-05-21-0181-R
- Wang, XW, Jiang J, Liu SL, Gafforov Y, Zhou LW. 2021. Species diversification of the coniferous pathogenic fungal genus *Coniferiporia* (Hymenochaetales, Basidiomycota) in association with its biogeography and host plants. *Phytopathology*. <https://doi.org/10.1094/phyto-05-21-0181-R>
- Wasser SP, Coates P, Blackman M, Cragg G, Levine M, Moss J, White J. 2005. *Encyclopedia of Dietary Supplements*. New York: Marcel Dekker; Reishi or Lingzhi (*Ganoderma lucidum*). 680-690.
- Wernig F, Buegger F, Pritsch K, Splivalloa R. 2018. Composition and authentication of commercial and home-made white truffle-flavored oils. *Food Control* 87:9-16. doi: 10.1016/j.foodcont.2017.11.045
- Wolf EV, Maleeva OF. 1969. World resources of useful plants. Nauka Publishing House. 563. (in Russian).
- Worldometers.info. 2021. <https://www.worldometers.info/world-population/central-asia-population/> (Accessed 03/12/2021)

Yatsiuk I, Saar I, Kalamees K, Sulaymonov S, Gafforov Y, O'donnell K. 2016. Epitypification of *Morchella steppicola* (Morchellaceae, Pezizales), a morphologically, phylogenetically and biogeographically distinct member of the Esculenta Clade from central Eurasia. *Phytotaxa* 284(1):31-40. doi: 10.11646/phytotaxa.284.1.3.

Živković J, Ilić M, Šavikin K, Zdunić G, Ilić A, Stojković D. 2020. Traditional Use of Medicinal Plants in South-Eastern Serbia (Pčinja District): Ethnopharmacological Investigation on the Current Status and Comparison with Half a Century Old Data. *Frontiers in Pharmacology* 11:1020.